

The Next Generation of SCORM: Innovation for the Global Force

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ABSTRACT

This paper summarizes the current progress and future direction of a research effort on the next generation of the Sharable Content Object Reference Model (SCORM). While the SCORM was successful in addressing high-level requirements to solve the challenges within military training systems, it was engineered prior to the widespread use of mobile devices, intelligent tutors, virtual worlds, games, and other new technologies that augment today's learner beyond formal training scenarios.

The DoD training community now requires support of a next generation solution to allow for the delivery and tracking of digital learning content on any device or platform. The approach detailed in this paper uses Activity Streams, a technology widely used in social media. Activity Streams are composed of three elements: an actor, a verb, and an activity, such as "John.Doe@acme.com completed Information Assurance 101".

This paper will reveal research findings for a future capability to support the tracking and delivery of digital learning content on any device or platform. This capability is not simply a replacement for SCORM, but it will further enhance the other types of learning opportunities that can be made available for the military training and education community.

ABOUT THE AUTHORS

Jonathan Poltrack has been involved with the ADL Initiative since 1999 where he was an early contributor to the SCORM. As a software engineer, he has contributed to many ADL software projects including the SCORM Test Suite, the Sample Run-Time Environment, the ADL SCORM RELOAD Editor and numerous content examples. Recently, Jonathan has led efforts aimed at transitioning the SCORM while specifying a new learning platform to support new types of systems and content. As a contractor with Problem Solutions, he provides support to the Advanced Distributed Learning (ADL) Initiative.

Jason Haag's interest and background is in learning systems, web technology, and standards. He spent eight years supporting the U.S. Navy's eLearning program in both engineering and management roles before joining the Advanced Distributed Learning (ADL) Initiative. He is currently employed by The Tolliver Group, Inc. and provides Systems Engineering and Technical Analysis (SETA) support for the ADL, sponsored by the Office of the Deputy Assistant Secretary of Defense (Readiness). He took on the duties of ADL's Mobile Team Lead in 2012. His primary focus is mobile learning, mobile device platforms & technology, and best practices for implementation. Jason's professional affiliations include serving as chair of the DoD ADL (DADL) Working Group, member of the IEEE Education Society, and member of the eLearning Guild. Jason received his M. Ed. from the University of West Florida where he specialized in Education & Training Management and Instructional Technology.

Nikolaus Hruska is a software engineer and researcher with over ten years of experience. He is currently working on the Next Generation SCORM project investigating new approaches to learning. He produces prototypes using emerging technologies to enable new learning scenarios such as mobile learning, simulations, and serious games. As a contractor with Problem Solutions, he provides support to the Advanced Distributed Learning (ADL) Initiative.

Andy Johnson has been working with Distributed Learning for over 10 years. He has been involved with the SCORM (Sharable Content Object Reference Model) since 2000, much of the time directly supporting its development as a part of the Advanced Distributed Learning (ADL) Initiative. He has also architected content structures supporting SCORM for various government projects, most notably the first JKDDC (Joint Knowledge Development and Distribution Capability) courses and a series of Pharmacy Technician Training courses designed for the services by the VA. He currently has the role of Senior Systems Engineer (a contractor through Problem Solutions) as a part of the ADL Program.

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In 2011, ADL produced a compilation of requirements for the next generation of the Sharable Content Object Reference Model (SCORM®) as part of a Broad Agency Announcement (BAA) funded research effort. The original title of the requirement for the BAA was the “Experience Application Programming Interface (API),” which sought to modernize the SCORM® communication framework. The BAA research effort collected community-derived use cases, reviewed over one hundred community-produced white papers, and conducted many one-on-one interviews with a variety of experts in the field of learning technology. As a result, ADL determined that one of the new framework’s top priorities was “simplicity.” However, it would still require some form of an API to consistently record information about learners and learning experiences. The outcome of the first phase of this research is a new communication technology called the “Tin Can API.” This new API is the first step toward providing the next generation of learning technology for the DoD which extends far beyond the capabilities of the SCORM. This paper reveals current research findings as well as the future research direction on providing a next generation of SCORM to better support tracking and reporting of experiential learning. The ultimate goal of this effort is to improve human performance and readiness within the military training and education community.

BACKGROUND

ADL created SCORM in 2001 to satisfy the high-level requirements of DoD training systems—enabling digital learning content to be accessible, interoperable, reusable, and durable. The SCORM was created to solve problems for the DoD training community, but through openness, collaboration, and partnerships, SCORM attracted significant attention from academic, corporate, nonprofit, and technology sectors. The impact of SCORM has been realized well beyond its origins in military training and education.

For example, one of the largest SCORM standard-based e-learning systems in Korea, known as the Cyber Home Learning System (CHLS), has over 1.6 million users (Wisher & Khan, 2010). Meanwhile, the DoD components each maintain e-learning systems and have accounted for tens of millions of SCORM course completions among the total force (active duty, reservists, and civilians) (ADL, 2012). In addition, as of 2012, there are more than three hundred and thirty certified SCORM products now available on the commercial software market (ADL, 2012).

While the SCORM was successful in addressing the high-level requirements to solve the challenges within web-based training systems, it was created prior to widespread use of other types of delivery platforms and learning environments such as mobile devices, intelligent tutors, virtual worlds, games, and other social networking tools. These capabilities augment the performance of today’s learner beyond formal training situations and into a variety of informal scenarios which cannot be tracked by traditional means.

The Next Generation of SCORM

The next generation of SCORM, formally named ADL’s Training and Learning Architecture (TLA), will include several components aimed at providing advanced capabilities not only for the United States, but also the Global Force. Legacy SCORM was based on very limited requirements, and older engineering practices that have been replaced by cloud computing and service-oriented architectures. The next generation of SCORM will provide beneficial learner-centric capabilities which are necessary as learners themselves evolve to learn beyond traditional methods. It is critical for the next generation of SCORM to leverage new approaches that are widely successful in the private sector today so these new methodologies aren’t stuck in 20th century technology.

The next generation of SCORM will provide a more agile environment and new opportunities for both

formal and informal learning. Today's servicemen and service women expect to leverage smart phones, games and simulations as part of their learning experiences. In addition, we anticipate the new capabilities of next generation SCORM will allow collection of new types of data and will ultimately provide a more personalized learning experience. Personalized learning creates new opportunities for improving readiness and efficiencies not just for the individual learner, but also for collaborative situations, whether they are in the classroom or in tactical field operations.

REQUIREMENTS

Research Need & Applicability

There is a global need to support both browser-based and out-of-browser learning activities which can record a learner's performance and experiences. SCORM supports interoperability and portability of web content on desktop or laptop computers, but is tied to tracking only browser-based activities within the structure of an LMS.

Since its inception more than ten years ago, SCORM has been widely adopted, but remained relatively static as the technology landscape changed. This, in turn has led to new demands, stretching SCORM beyond its original intent. For example, some implementations of SCORM for other content modalities and platforms (e.g. other than self-paced training in LMS applications) have led to the creation of middleware or proprietary technology. The use of this type of non-standard, proprietary technology has resulted in fragmented solutions and content developed for a specific Learning Management System (LMS). Consequently, there have been instances where the high-level goals and requirements of SCORM, such as interoperability and portability, are usually achieved only after several additional hours of modifying the content to work in a particular LMS implementation.

Another much sought after requirement for distributed learning platforms is the capability to create and use value-added services (e.g. competency-based analytics, reporting, etc.) which read data from learning records such as scores, completion status and success status. SCORM is effective in describing how a learner's active session with learning content passes learning data to an LMS. However, SCORM does not currently describe how or if the LMS displays the data to the learner. This situation means the people who need the data the most may not have access to it. For example, a course administrator may not be able to access scores for all learners in a course. The LMS stores the data, but SCORM doesn't specify how the LMS should expose it.

Gathering Requirements

There is a clear need for a more efficient communication mechanism based on advances in modern software technology. Supporting more than browser-based learning experiences and exposing the stored learning data are two examples of high-priority and widely requested features by the SCORM community. These only scratch the surface of the extensive set of use cases to be supported moving forward for the next generation of SCORM.

Crowdsourcing

"Crowdsourcing" means a task or problem is outsourced to an undefined public rather than to a specific body, such as paid employees (Wikipedia, 2012). Crowdsourcing usually involves outsourcing tasks to a distributed group of people. This process can occur both online and offline. To collect use cases, ADL, through the aforementioned Experience API BAA effort, used a crowdsourced requirements gathering tool, www.uservoice.com, where those involved in e-learning could state their requirements and constraints. These responses ranged from the shortcomings of SCORM to ideas beyond what is technologically possible today.

Recently, crowdsourcing has become quite a phenomenon for generating ideas, interest, and information quickly, especially when combined with a form of competition.

"The Internet's viral communication mechanisms, which allow information about the competition to spread faster and more widely than it would even via mass media, mean that an open online competition has the potential to reach an unlimited number of possible idea givers at a comparatively low cost." (Schweitzer, 2012) In an Austrian study, crowdsourcing, taking on the form of a competition, was four times as effective as focus groups in generating ideas. (Schweitzer, 2012) It seems if the spark of competition is there, learning may not require an established community.

The City of San Francisco demonstrates the benefit of crowdsourcing competition in its public transportation applications. San Francisco releases its raw public transportation data via web service APIs. This has enabled citizen developers to write over ten different mobile applications to help the public navigate San Francisco's public transit systems – more services than the city could provide if it focused on presentation development rather than opening the data publically through web services (Office of the White House, 2012). Exposing data through web APIs provides a

means for interoperability but also allows innovation of learning content, experiences and systems, not easily afforded in the legacy SCORM model.

As a result of effectively employing the crowdsourcing approach, the SCORM community collectively identified the next generation of SCORM must support distributed learning, support intermittent activity, expose personal learning data, and track learning which falls outside the domain of the traditional LMS. These are not all inclusive of the requirements collected from the community, but those not mentioned in this paper are simply related to broken features, outdated technologies and better lifecycle management. As a result of the BAA research effort and crowdsourcing, we identified that tracking of all types of learning experiences is an important part of the new communication framework for the next generation of SCORM.

SOCIAL LEARNING

Learning Experiences

Learning is acquiring new, or modifying existing, knowledge, behaviors, skills, values, or preferences and may involve synthesizing different types of information (Wikipedia, 2012). A learning experience is the result of one's encounter with a learning activity taking place in an informal, formal, or blended setting. From a learner's perspective, he or she is experiencing something resulting in a change in thinking, understanding, or behavior. This represents a shift from the typical view of content – that somehow learning (and especially learning to do or understand) is transmitted from the content to the learner simply by presenting content to the learner with intent to absorb it. With such a passive view of content and of the learner's experience, it's no surprise the pedagogical merits and learning experiences based on SCORM have been limited (Gallagher, 2011). SCORM was implemented prior to the widespread use of social networks for learning. Many LMS implementations have even gone as far as to try and provide social networking features and widgets in their products as today's learner expects to be engaged by more than just self-paced courses. However, the data from these other types of learning experiences are often not recorded for later recall or even leveraged for performance support. Instead, the LMS environments are simply recording self-paced training or instructor-led events and usually not supporting any other types of learning experiences.

Social Networks and Learning

Social networks focus on building online communities of people who share common interests or activities or who are interested in exploring the interests or

activities of others (Wisher & Khan, 2010). Learning through a wide variety of social networking media, such as Twitter and Facebook, has led to a new paradigm called social learning.

When choosing whether or not to acquire new information, people often rely on resources outside of their personal experience and look to their trusted network to help make their decision (Lamberson, 2010). Social learning provides opportunities for learning from one another by observing the behavior of others and sharing the outcomes of those behaviors (Zhou, Piao & Jin, 2011).

Embracing social networks for learning shows people are no longer learning only from teachers or by themselves, but also through interacting and collaborating in a community or across a social network. The opportunity presented with this new paradigm is social media data can now enable the capture of learning artifacts in order to assess the learning, link the learner to experts or mentors, and provide recommendations based on granular learning data collected over time. In addition, social media can capture a teacher's activity in their personal learning networks in a formal or blended environment.

APPROACH AND EARLY FINDINGS

Activity Streams

Many research efforts apply the data which comes from social networks in the form of "streams" A variety of social media applications contain a tremendous amount of activity streams, arousing interest in integrating activity streams into the learning process.

Recent research studies have examined an integrated approach to extract learning stream data and then organize the data into meaningful learning contexts. For example, the experimental evidence shown in the analysis of Twitter data streams shows Twitter being used effectively as an educational tool to help foster student engagement. In addition, using Twitter to post social, scholarly, or a combination of these types of information has led to improvements to the perceived credibility of the instructor in blended learning environments (Zhou, Piao & Jin, 2011). Additional research by Zhou & Jin (2011) proposed a Dynamical Socialized User Networking (DSUN) model, which represents learners' current profiling and dynamical relationships based on their current interests captured from activity streams in web-based learning environments.

The use of activity stream data for learning has spawned several new research questions: How can activity streams apply to all of the different ways we can learn? How might we model an interaction between people and content, regardless of whether the content is web-based, on a mobile device, in a virtual world, or in a serious game? More importantly – how might this approach change the landscape to accelerate and, perhaps, enhance the way we learn?

The next generation of SCORM will help us realize answers and solutions for these exact research questions. In order to make the data in one system transferable to other systems, we have determined an interoperable way to encapsulate and exchange learning data through the use of a learning-based activity streams. This data should include defined actors, verbs and activities associated with the learner's participation in learning experiences so the data exchanged holds some shared meaning.

Activity Streams and Semantics

An activity stream can be thought of as a triple. A triple is an expression used in the Resource Description Framework (RDF) World Wide Web Consortium (W3C) specifications and make up the basic components of semantic web. They describe content items such as "Mark Twain wrote Huckleberry Finn" and allow for relationships to be inferred across a broader data set and answer questions such as "what else did Mark Twain write?" The RDF data model is similar to classic conceptual modeling approaches such as entity-relationship or class diagrams, as it is based upon the idea of making statements about resources (in particular Web resources) in the form of subject-predicate-object expressions (Wikipedia, 2012). These expressions relate data together and the resulting relationships can be used to infer information through semantic analysis.

A primary example of semantic analysis is how Google knows so much about us and the types of content we are seeking. Google tracks a rich set of information about its users and then applies innovative algorithms to supply the most relevant content during a search. For example, when typing "First," you may receive results back for "First National Bank" based on your location and history of use. This in itself is remarkable as historically, items like "First President" and "First World War" have been searched for many more times and could likely be what the searcher is looking for. However, Google "knows" this isn't the case because of semantic analysis.

Further, when finding "First National Bank," Google "knows" a wealth of information about it. For

example, the phone number is linked so a phone can dial with a single click, the location is shown on a map and directions are available given one's current location. This is accomplished via semantics. Google's systems make meaning out of the context of where you are and what you and/or others are searching for as well as the actual words you enter in your search query. We propose learning systems should also be able to provide this capability by leveraging a rich set of semantically friendly data.

The gaming industry also uses the triple concept via activity streams. Many video games, especially Massively Multiplayer Online Games (MMOGs), use activity streams to communicate data to users. Statements like "Zoltar obtained 86 gold" or "Red Team launched homing missile" are commonplace within online gaming. SCORM doesn't have the ability to track such information in a robust way. As the avenues of simulations and video games become more populated with educational content, tracking the experiences individuals and groups have within them will be paramount.

Facebook released its own implementation of an activity stream platform using Open Graph, which makes verbs and activities extensible, allowing them to be defined by applications connected to Facebook. For example, instead of saying "Jonathan likes *The Odyssey*," Open Graph allows applications to report that "Jonathan read *The Odyssey*" (or "Jonathan hiked The Appalachian Trail"). Even though Facebook does not have an internal implementation of "hiked," it's able to provide meaning to this statement via Open Graph and semantic analysis.

Project Tin Can

Project Tin Can was the first step toward supporting the next generation of SCORM. While the overall research effort for a new capability to replace and further extend the capabilities of SCORM is not complete, the results from Project Tin Can have produced several findings, helping ADL guide the future direction of ADL's research.

This project began by collecting requirements from surveying and organizing use cases for the next generation of SCORM. A previous research effort called SCORM 2.0 resulted in the submission of over one hundred research white papers by SCORM users. In addition to reviewing the whitepapers, ADL compiled survey data and merged similar topics to determine the most prevalent issues to be addressed in the next generation of SCORM. The following is a list of the top three user requirements based on feedback collected during Project Tin Can:

1. Should support a variety of content types
2. Should be simple to implement
3. Should support offline or disconnected scenarios

In addition to identifying the use cases and requirements relevant to the next generation of SCORM solution, the project team also identified current best practices and technologies (e.g. Activity Streams) mature enough for inclusion in the new architecture. These techniques were applied in a learning context and matched with the highest priority requirements.

Another concept proposed as a result of Project Tin Can was the Learning Record Store (LRS). The LRS is a service rather than an enterprise system. An LRS is more agile and can support any networked platform or content modality. It can take and process activity stream data and report them back to the user or authorized system.

The LRS would remove previous SCORM requirements for an LMS. This isn't to say the LMS would become obsolete, but the requirements dictated by the resulting specification would limit the function of the LRS primarily to the storage and retrieval of learning records. All of the user management, sequencing, user interface controls, course management, etc., would be out of scope of the LRS.

The Tin Can API

The Tin Can API, formally named the TLA Experience API, is the resulting technology from the Project Tin Can BAA effort. The Tin Can API is merely one of several components of the next generation of SCORM. The first major effort of the Tin Can API was to determine the different types of verbs and activities appropriate for learning as adopted from the activity stream specification <actor><verb><activity> or "I did this" model. While the Activity Stream's specification focuses on the publisher, the Tin Can API has a vocabulary structure focusing on the learning experience and the learner. The Tin Can API can be thought of as the communication component of the next generation of SCORM just as the Run-Time Environment (RTE) was the communication component of legacy SCORM. ADL will likely provide a SCORM RTE equivalent for tracking all of the legacy SCORM training activity data such as "score," "success," "completion," "attempt," and "response."

In addition, communities of practice will enforce certain behaviors and taxonomies by creating their own vocabulary profiles. A virtual world training community may define hundreds of verbs that relate to the large context of training in another world.

Short-term Objective: Mobile Focus

The high accessibility of mobile devices, coupled with the power of social networks, makes it possible for performance of collaborative learning activities at any time and place. Current efforts for the next generation of SCORM focus on the new opportunities provided by the Tin Can API such as tracking, data, analysis, and reporting. The scope of this second phase defines a standard set of verbs and activity definitions for mobile content, including both web and native applications.

The Army's Connecting Soldiers to Digital Applications (CSDA) program has pilot programs through which soldiers can access apps on iTunes and Google Play. These provide unclassified, publicly available, information to the soldiers, but the mobile apps and information contained within them is not integrated with any military systems because of the limitations of SCORM. Our short-term focus is to conduct prototype work with DoD stakeholders on incorporating the next generation SCORM into their mobile learning applications.

The technologies and communication protocols currently used in legacy SCORM (JavaScript and HTTP) are durable and allow for the content to communicate in the mobile browser. However, they must be optimized to allow for other types of mobile content delivery and to improve overall performance on mobile devices having limited bandwidth or no connectivity at all. The Tin Can API addresses the shortcomings in legacy SCORM and allows for more secure tracking of mobile content and apps.

Long-term Objectives

Future phases will include standard activity stream definitions for games, simulations, and augmented reality used within learning communities to define domain-specific statements (ex. Medical Community, DoD, Higher Ed).

Another one of the top-rated requirements for next generation SCORM by the user community was movement beyond the single learner approach. Such movement allows team-based exercises, collaboration, and direct instructor intervention. The next generation of SCORM will enable group learning, informal learning, and social learning while allowing tools for roles other than the learner. For example, instructors can create content to use in a classroom exercise to

monitor a group of learners and provide immediate support.

Just as with the crowdsourcing example referenced with the city of San Francisco's public transportation application, ADL expects its community to use the Tin Can API to create features for purposes we have not envisioned. The use of an open API and an extensible data model creates an environment with a large amount of actionable data. Not only does the Tin Can API support the new types of learning experiences emerging today, new types of experiences adaptive to an individual's learning history, profile and preferences can use it. Such advancements truly enable high quality education and training anywhere, any time on any device.

ADL, through conduction of additional research and development efforts, is determining the other critical parts of the next generation of SCORM. A future research area related to the next generation of SCORM is the Personal Assistant for Learning (PAL). The topics of mutual interest in these research activities include, but are not limited to, the following:

- device integration and delivery,
- social learning devices,
- experiential learning,
- just-in-time content brokering,
- progressive content,
- social architecture,
- learner profile technologies,
- educational informatics,
- information lifecycle management,
- intelligent tutoring,
- open independent learner models,
- cognitive adaptability,
- semantic determination,
- learner history,
- virtual environments and application of virtual environments,
- social problem solving,
- promotion of learner adaptability and improvement of retention,
- and self-directed learning.

Conclusion

The next generation of SCORM will result in innovative solutions enabling not just the US total force, but the global force -- the theme of this year's IITSEC. The goals of the next generation of SCORM are to provide the DoD and Services with access to the highest quality education and training anytime, anywhere in order to best prepare the Warfighter. However, limitations with the current SCORM specification make it difficult to meet the current and

future needs of the Warfighter in today's highly advanced world of new devices and capabilities. In order for our servicemen and servicewomen to truly leverage mobile applications, simulations and games as part of a distributed learning environment, a next generation of SCORM must not miss its mark. By adopting the research findings in this paper, learning content would become more interoperable and a learner's experiences would be shared by more than just the LMS applications of today's DoD training systems. In order to achieve adoption on a global scale, the next generation of SCORM must have a strategy in place to support the global force. The technical solutions proposed in this paper are significant steps in that direction, and toward truly improving the training and educational capabilities of our global force.

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